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ARMY INST OF DENTAL RESEARCH WASHINGTON DC  
A CLINICAL AND LABORATORY COMPARISON OF ALGINATE IMPRESSION TEC--ETC(U)  
SEP 81 J O HOLLINGER, L LORTON, W A KRANTZ

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
		AD-A105443
4. TITLE (and Subtitle) A Clinical and Laboratory Comparison of Alginate Impression Techniques		5. TYPE OF REPORT & PERIOD COVERED Manuscript for Publication
7. AUTHOR(s) MAJ Jeffrey O. Hollinger, DDCR LTC Lewis Lorton, DDCR and MAJ William A. Krantz, DDCR		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS U. S. Army Institute of Dental Research Walter Reed Army Medical Center Washington, DC 20012		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS 61102A; 3S161102BS06 Task Area 04; Work Unit 010
11. CONTROLLING OFFICE NAME AND ADDRESS U. S. Army Medical Research & Development Command HQDA-IS Fort Detrick, Maryland 21701		12. REPORT DATE 4 September 1981
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		13. NUMBER OF PAGES 12
		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) This document has been approved for public release and sale; its distribution is unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES None		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) <b>B</b>		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A clinical and laboratory comparison of alginate impression techniques was undertaken. Rim-lock® trays were modified with a combination of modeling compound, wax, and alginate adhesive. Both the modified and unmodified trays were used to make alginate impressions of either standard laboratory maxillary and mandibular models or maxillary and mandibular arches of dental patients. The stone casts that were subsequently fabricated were evaluated with a measuring microscope and by ten dentists assessing the accuracy of fit of a prepared occlusal plaster		

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index to the stone casts. It was determined that the most accurate stone models could be made from an alginate impression technique using a Rim-lock® tray modified with modeling compound and an alginate adhesive.

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A CLINICAL AND LABORATORY COMPARISON  
OF ALGINATE IMPRESSION TECHNIQUES

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## INTRODUCTION

Alginate is the impression material most often used in dentistry. The popularity of this irreversible hydrocolloid is attributable to its ease of manipulation, the flexibility of the set impression, the accuracy of the impression if handled properly, and the low cost.<sup>1</sup>

Several articles have appeared in the literature establishing guidelines for the proper handling of alginate.<sup>2-4</sup> Various papers also have been written that explained the importance of the relationship between the impression tray and the alginate material.<sup>5-8</sup> Retention of the alginate in the impression tray upon removal from the oral cavity was singularly critical in this relationship. In one study, it was demonstrated that the separation of the set alginate from the tray was often imperceptible at chairside.<sup>7</sup> This separation could result in a distorted impression. Stone casts prepared from such an imprecise impression would be inaccurate, and if these casts were to be used for the fabrication of a partial denture framework, the framework would be clinically unacceptable. It is apparent, therefore, that the set alginate material must be securely adapted and "locked" to the impression tray.

## PURPOSE

The purpose of this investigation was to examine clinically and in the laboratory, a modified and unmodified Rim-lock® tray used with an alginate impression material for the accurate recording of detail.

## MATERIALS AND METHODS

### A. Laboratory

Models of maxillary and mandibular partially edentulous arches (referred to as standards) were made using a combination of metal and acrylic. Landmarks (machined indentations) in the second molar, buccal vestibule, bicuspids, and cuspid teeth were prepared and designated as A, B, and C (Figure 1). A total of sixty alginate impressions were made of the standard maxillary and mandibular arches using five different techniques. These techniques consisted of:

1. An unmodified Rim-lock® tray with alginate impression material.\*
2. An unmodified Rim-lock® tray with an alginate adhesive† and an alginate material.
3. A Rim-lock® tray modified with modeling compound‡ for the support of and to insure for an even thickness of between one-eighth and one-fourth of an inch of alginate impression material (Figure 2).
4. A tray modified with red beading wax to allow for a thickness of one-eighth to one-fourth of an inch of alginate.
5. A tray modified with modeling compound as in 3., but with the additional use of an alginate adhesive.

\*Alginate - Coe Laboratories, Chicago, Illinois

†Hold Spray-On Tray Adhesive, Teledyne Dental, Elk Grove Village, Illinois

‡Impression Compound, Kerr-Sybron Corp., Romulus, Michigan

The standard models were kept in a dry, 37°C oven until the time the impressions were made. The alginate was appropriately mixed, and an impression was made of the standard. A 100% humidity, 37°C environment was maintained until the alginate was set.

In all three techniques the alginate material was handled precisely according to the manufacturer's specifications. Room temperature distilled water was used. After the alginate was set, master casts were immediately poured using a vacuum mixed, improved stone\*\* with a double pour technique. Each cast was separated from the set impression one hour after the initial pour and was then allowed to set for 24 hours before measurements were made between the machined landmarks using a measuring microscope.

For comparison with the alginate material, custom acrylic trays were made and polysulfide rubber was used to prepare 20 impressions of the maxillary and mandibular standards. Master casts were then poured according to the method previously described. The distance between landmarks was measured as mentioned earlier.

#### B. Clinical

Twenty patients were chosen who had partially edentulous maxillary arches. Each arch had at least three posterior teeth in both left and right quadrants. Three alginate impressions were made on each patient using an unmodified tray, a tray modified with modeling compound, and a tray modified with modeling compound and alginate adhesive. For each

\*\*Stone, Dental - Ransom and Randolph Co.

patient, a bite stone<sup>††</sup> occlusal index was made using an FGP tray.<sup>‡‡</sup>

Ten dentists participated in the blind evaluation of the relationship of the occlusal index to the trio of maxillary casts prepared for each patient. Each index was assessed according to:

1. The degree of the fit of the occlusal index to the occlusal surface of the maxillary teeth, and judged as either (1) best; (2) adequate; or (3) poor.
2. The clinical acceptability or nonacceptability of the index to the cast, and marked as + or -.

#### RESULTS

##### A. Laboratory

The mean values of the percentage difference between the experimental casts and the originals are given in Graphs 1 (maxillary) and 2 (mandibular).

Analyses of variance for each dimension were done. Only the BC measurement of the compound adhesive group of the maxillary casts approached significant difference from the other measurements.

The percent variation of the mandibular casts was very high and there were several instances of significant differences (Table 1).

##### B. Clinical

The results of the clinical comparisons are rather ambiguous. For each patient, each of ten evaluators evaluated three different casts for their adaptation to the bite-stone occlusal index. Each evaluator assigned a rank of (1) best; (2) adequate; or (3) worst to the casts. Therefore, for each set of three casts and occlusal index, ten groups

<sup>††</sup>Snow White Impression Plaster #2, Kerr Laboratory

<sup>‡‡</sup>FGP Trays, Lactona/Surgident Products

of scores 1, 2, and 3 were generated. The rankings for each set were evaluated separately to see if there was any agreement among the evaluators using the Kendall coefficient of concordance. At the .05 level of significance, only ten of the twenty differed from randomness. By relaxing the requirements for significance to .20, seventeen sets of evaluations could be considered. A Ridit analysis of these data indicated that using a tray and compound combination would result in an impression that would fit the index better approximately 50% of the time compared with that made using a tray alone. Using a tray, compound, and adhesive, the chance of producing a cast judged to be better fitting was accomplished 62% of the time.

The distribution of the scores is seen in Table II.

When the fit of the occlusal index to the stone cast was judged as being either acceptable or not acceptable (Table III), the techniques again showed the same relationship ( $p < .05$ ), that is, the compound plus adhesive was better than compound alone, and compound alone was better than an unmodified tray.

#### DISCUSSION

McCracken says that "irreversible hydrocolloids are sufficiently accurate for the making of partial denture master casts when properly handled."<sup>10</sup>

If a stock tray is to successfully support, confine, and then compress the alginate evenly, it must be enhanced with a relatively stable material such as modeling compound. Modeling compound is a material traditionally used for the modification of impression trays and has

proven to be stable enough for this task. A modified stock tray must conform to the topography of the oral structures to be recorded so that a supported, uniform thickness of one-eighth to one-fourth of an inch of alginate is achieved when the impression is made.<sup>4</sup> By developing an even layer of supported impression material, distortion is minimized. Bulky areas, such as in the palate of an unmodified tray, sag away from the palate and may shrink more in actual volume than thinner portions.<sup>2</sup> A master cast made from this impression will be inaccurate. If such a cast were to be used for fabrication of a metal partial denture framework, the metal framework would be inaccurate. The palatal part of the framework would be smaller than the palatal part of the mouth, even though the major connector crossing the palate adapted well to the master cast.<sup>4</sup>

Rudd, Morrow, and Strunk<sup>3</sup> recommend a stock, Rim-lock® tray which is nonperforated for the alginate impressions of partially edentulous patients. Kroll<sup>8</sup> advocates a tray design that will ensure retention of the set alginate when withdrawn from undercuts. He states that a perforated tray is desirable and that the perforations should be large enough to allow for the impression material to flow through, and upon setting, to form a mechanical lock. Heartwell<sup>11</sup> maintains that there is no difference between perforated and nonperforated trays. Kroll<sup>8</sup> mentions that nonperforated trays require an adhesive to produce a positive attachment to the alginate. Rudd, Morrow, and Strunk<sup>3</sup> state that once alginate is loosened from an impression tray, it will not go back precisely to place. Jordan<sup>5</sup> and Rudd, Morrow, and Strunk<sup>3</sup> have

recommended the addition of cotton fibers imbedded in beeswax or modeling compound to increase the retention of the alginate within the impression tray. Atkinson, Gill, and Shepherd<sup>6</sup> have proposed the application of hot sticky wax to the tray prior to placing the alginate impression material. However, this technique may not be prudent, because the hot sticky wax may deleteriously affect the alginate and result in a distorted impression. Wilson and Smith<sup>12</sup> conducted a series of laboratory experiments to evaluate the tensile and shear bond strength of alginate adhesives. Their results showed that the addition of alginate adhesives significantly increased the force necessary to break the alginate-tray bond.

In the laboratory aspect of this study, it was found that regardless of which impression technique was used for the maxillary standard, the relative dimensional changes (as noted by the distance between prepared landmarks) were the same. For the mandibular standard, the impression techniques showed a variety of types of distortion between the standard model and the experimental stone model. The greatest degree and variety of distortion occurred in measurements across the unsupported tongue space.

For the clinical evaluation, it appears that the Rim-lock® tray modified with compound and alginate adhesive results in the most accurate production of stone casts, according to the ability of the dental examiners to relate an occlusal index to the prepared stone cast. It would be prudent, therefore, for the clinician to develop a uniform, supported thickness of alginate by modifying the metal, Rim-lock® tray. An alginate adhesive is also recommended to help produce an accurate impression and a subsequently precise stone cast.

CONCLUSION

A metal, Rim-lock® tray, modified with modeling compound and an alginate adhesive, resulted in a more accurate impression than an unmodified Rim-lock® tray when evaluated both in the laboratory and in the clinic.

MILITARY DISCLAIMER

Commercial materials and equipment are identified in this report to specify the investigative procedure. Such identification does not imply recommendation or endorsement or that the materials and equipment are necessarily the best available for the purpose. Furthermore, the opinions expressed herein are those of the authors and are not to be construed as those of the Army Medical Department.

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TABLE I

<u>Dimension</u>	<u>Largest % Distortion</u>					<u>Smallest % Distortion</u>
AB	<u>MTA</u>	MT	<u>CO</u>	<u>CA</u>	<u>RB</u>	WA
BC	CO	<u>RB</u>	WA	MT	<u>MTA</u>	CA
CA	MTA	<u>RB</u>	<u>CO</u>	CA	WA	MT

LEGEND: Techniques connected by underlining are not statistically significant.

MT Metal Tray  
MTA Metal Tray Adhesive  
CO Compound  
CA Compound and Adhesive  
WA Wax and Adhesive  
RB Rubber Base in Custom Tray

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TABLE II

Total Numbers of Ranks by Categories of All Evaluators for All Casts

	#1 (best)	#2 (adeq)	#3 (poor)
Tray Alone	35	67	68
Tray + Compound	57	65	48
Tray + Compound + Adhesive	78	38	54

TABLE III

	<u>Acceptable</u>	<u>Not Acceptable</u>
Tray Alone	152	48
Tray + Compound	168	32
Tray + Compound + Adhesive	184	16

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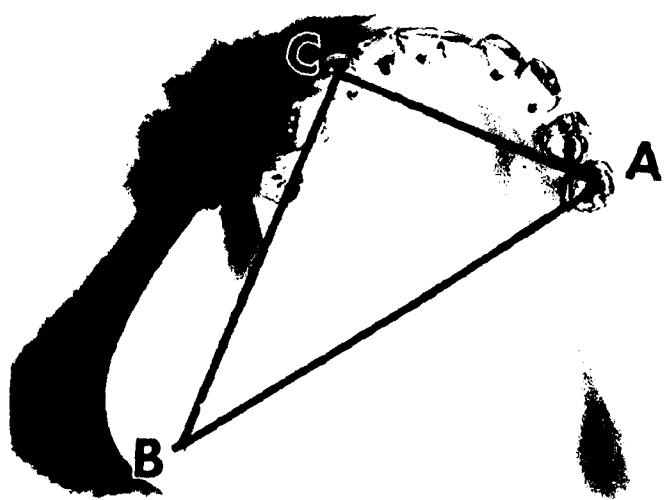
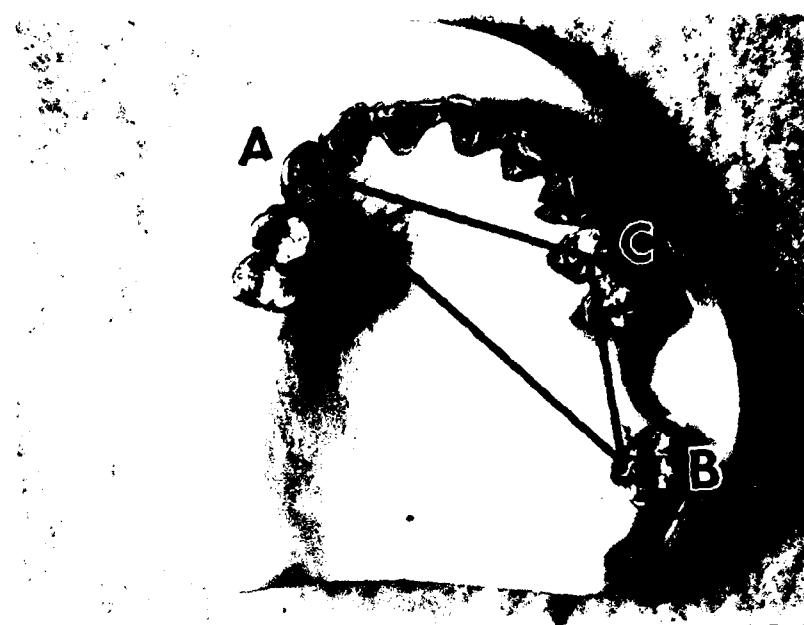
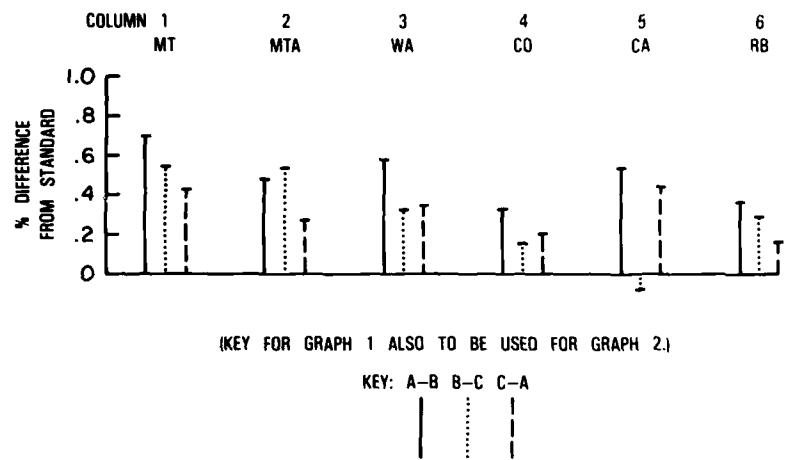


FIGURE 1. Landmarks (machined indentations) in the second molar, buccal vestibule, bicuspids, and cuspid teeth were prepared and designed as A, B, and C. Lines were drawn connecting letters A-B, B-C, and C-A.



FIGURE 2. Rim-lock® tray modified with modeling compound for the support of, and to insure for, an even thickness of between one-eighth to one-fourth of an inch of alginate impression material.

GRAPH 1: MAXILLARY ARCH. MEASUREMENTS MADE ON STONE CASTS.



MT = METAL TRAY

MTA = METAL TRAY + ADHESIVE

WA = METAL TRAY + WAX

CO = METAL TRAY + COMPOUND

CA = METAL TRAY + COMPOUND + ADHESIVE

RB = CUSTOM ACRYLIC TRAY + RUBBER BASE IMPRESSION MATERIAL

GRAPH 2: MANDIBULAR ARCH. MEASUREMENTS MADE ON STONE CASTS.

